

NASA GRC

# High Altitude Balloons at NASA GRC



For  
Ohio Space Grant Consortium  
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# Why High Altitude Balloons?

## Service

# Service Solar Cell

# Why High Altitude Balloons?

Relatively low cost access to near  
*space* conditions.

"Poor man's space program"

HAM radio equipment

Payload development

Can be simple

Parts + labor

Launch costs

Transportation

Balloon

Helium

Labor

Tracking/recovery

Ham Radio equipment

Transportation

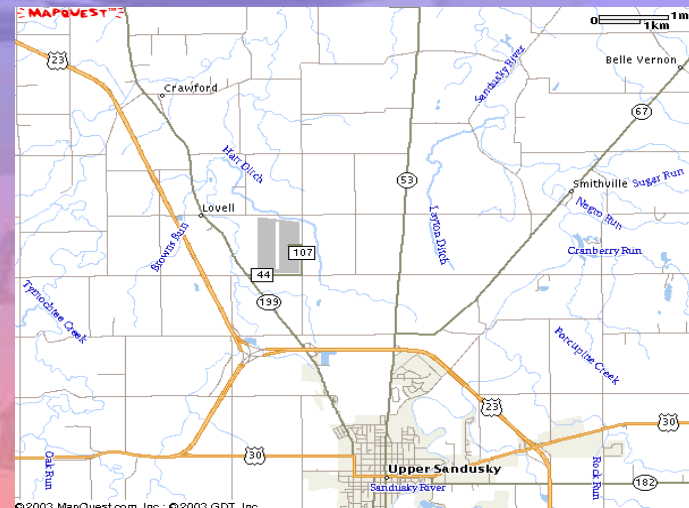
Labor

Reach 30 to 35 km

10 to 5 mbar (above 99% atm)

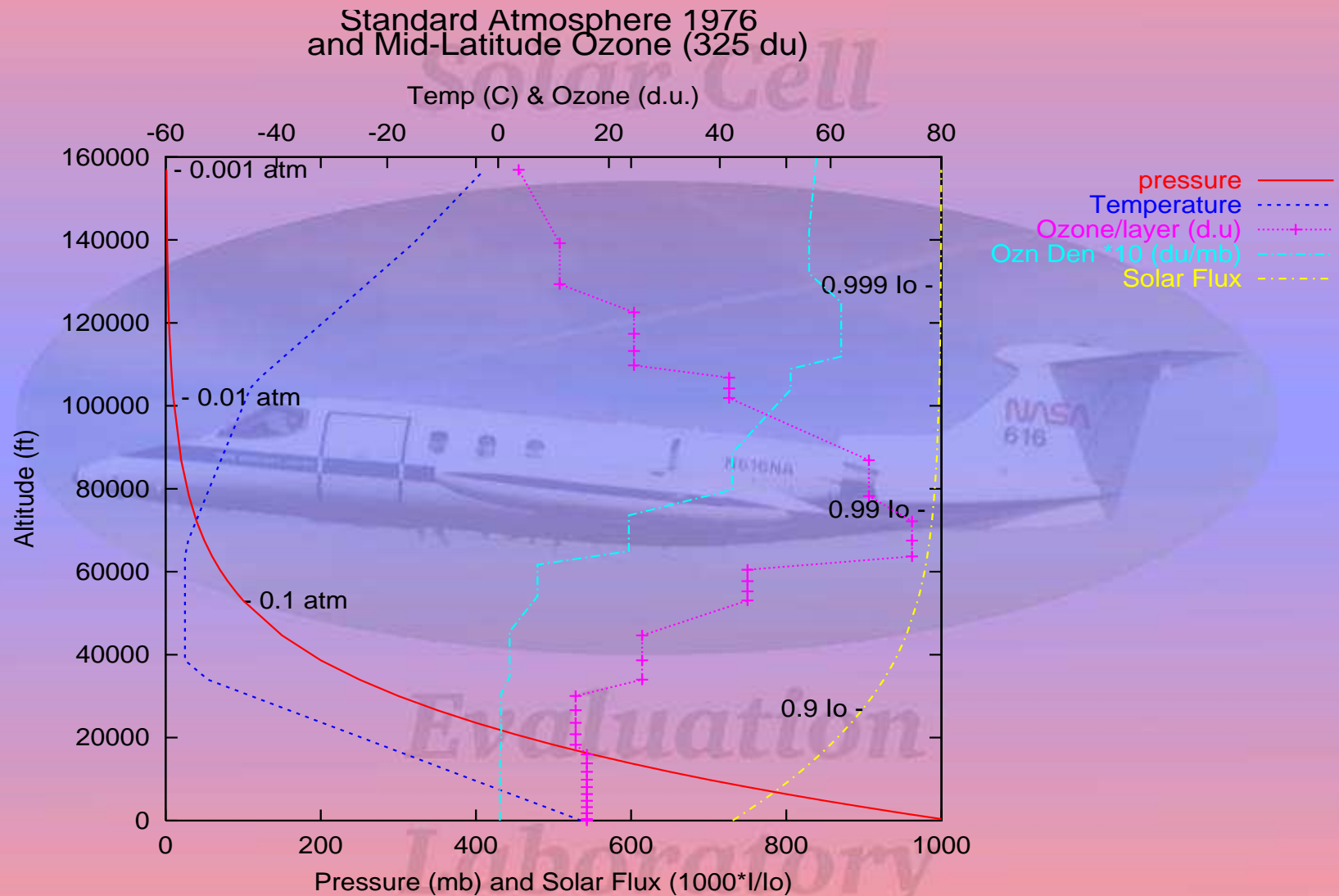
## Why Ohio?

- Suntracker Launches from Western Ohio/Eastern Indiana
- Flat
- Rural (low population density)
- Good Access
  - grid of roads
  - Nearly every mile
  - Still close to cities.



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# Atmosphere



# NASA Solar Cell Calibration

GOAL: Determine Solar Cell Performance in space.

- JPL Balloon Program

- 120kft, above most of the Ozone (Air mass 0.004)
- 2 to 4 flights/year in Summer
- \$5000/cell

- GRC high altitude aircraft

- Lear 25, Data from 35 to 50 kft (Air mass 0.18, below Ozone layer)
- 35-40 flights in late Fall through Winter
- \$15000/flight with up to 6 solar cells

## Potential Balloon Program

- Proposed by Jim Woodyard, Wayne State University, Detroit
- Use weather balloon technology
- 100kft, (air mass 0.02) top of ozone layer.
- Could fly most of the year.
- \$3000/flight for several cells, could be operated by solar array manufacturers

## Suntracker Demonstration

- 5 lb. Package
- 90kft
- Launch, GPS assisted tracking and retrieval
- Sun Tracking
- 8-bit A/D demonstrates feasibility of SC calibration (really need 12 or 16 bit)
- 2m packet radio data transmission (1200 Baud), and 70cm video



# Suntracker Systems

Like satellites, balloon payloads have weight and power limits.

- Unmanned free balloons are covered under section 101 of the Federal Aviation Regulations.  
<[http://www.eoss.org/pubs/far\\_annotated.htm](http://www.eoss.org/pubs/far_annotated.htm)>
  - Under 4-6 lbs need only notify FAA of plans, and file a verbal NOTAM, so pilots are warned of the flight. Learn procedures from other balloon groups.
- Limited weight implies limited power. Usually Lithium D cells

## Payload (5 lb)

- Suntracker (2m system)
  - GPS
  - Motor drivers, Zero-backlash gears
  - Electronics (MIM (inc Packet radio telemetry) , Basic Stamp 2p, PIC 16F84)
  - Battery Pack
  - Voltage regulators
  - 2 meter radio (300 mW)
- Video system (70 cm system)
  - Color camera
  - 1 watt UHF TV transmitter
  - Video overlay circuit board
  - GPS
  - Battery Pack (4 lithium cells)
  - Voltage Regulators
- Antennas
- Package urethane foam (10 in dia x 10 in)

## References & possible Projects

### Balloon Web sites

- <http://www.amsat.org/amsat/balloons/balloon.htm>
- <http://www.eoss.org>

### Suntracker Papers

- <http://www.ewh.ieee.org/reg/4/Mirza.pdf>

### Projects?

- Atmosphere Profiles
  - Pressure vs Altitude
  - Residual Gas Analyzer
  - Solar spectral absorption
  - Geomagnetic field
- Particle capture
  - Dust (terrestrial, extraterrestrial, biological)
- Astronomy
  - UV, IR, cosmic ray
- Remote Sensing
  - Ground imaging
  - Land use
  - Pollution

***The Sky is not the limit***